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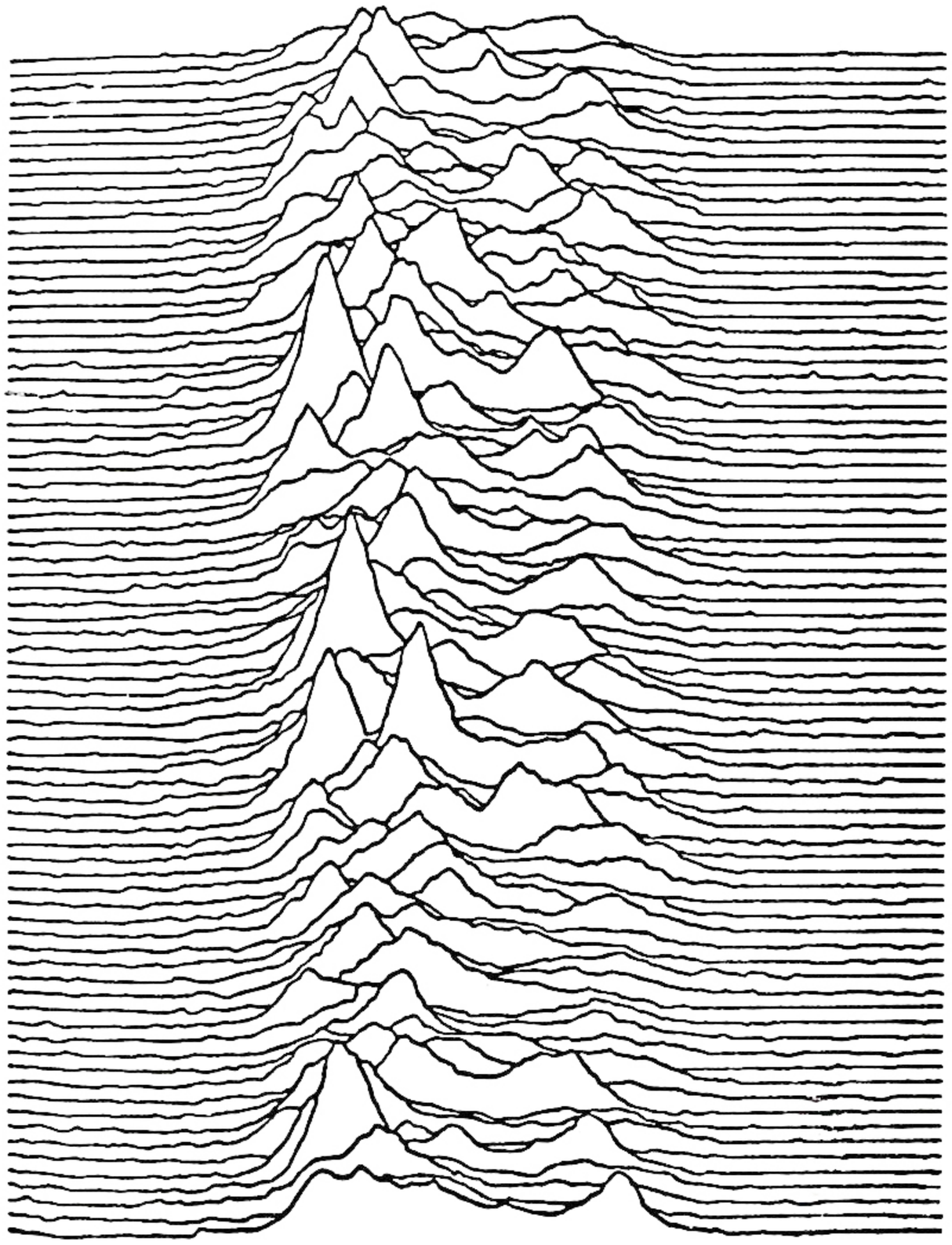

Successive pulses from the pulsar CP 1919

THE MYTHICAL UNIVERSE OF MODERN ASTRONOMY

by Dewey B. Larson

ANOTHER LOOK AT THE PULSAR PHENOMENON

by K.V.K. Nehru

PROGRESS ON THE THEORETICAL CALCULATION OF COHESIVE ENERGY OF THE ELEMENTS

by Ronald W. Satz

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THE MYTHICAL UNIVERSE OF MODERN ASTRONOMY[1]

by Dewey B. Larson

For the past two or three years I have been spending all of the time that I could make available for the purpose on the preparation of additional volumes of the revised edition of my first book, The Structure of the Physical Universe. As I think most of you know, the first volume of that revised edition has already been published with the separate title of Nothing But Motion, and I am now working on the next two volumes, concentrating mainly on volume III, which will probably be completed and published ahead of volume II. That may seem like the wrong way of going about it, and perhaps it is, but there are good reasons for it, which I won't go into now.

Volume III is the astronomical volume. In that I am taking the physical laws and principles developed in volumes I and II, and applying them to the astronomical situation. The results that I have obtained in so doing are quite different from what you find in the astronomical literature -- so much so, in fact, that you might almost wonder if we are talking about the same thing. And I am quite sure that those who read the book will want to ask a question that goes something like this: If your results are correct, how in the world did the astronomers arrive at such totally different conclusions? Since that question is going to be asked, I think that I should answer it right in the book itself and I am planning on putting in a chapter for that purpose. What I propose to do this evening is to give you a general idea of the contents of that chapter.

What the astronomers have done is essentially the same thing that I've done. That is, they have taken the physical laws and principles to which they subscribe and have applied them to the astronomical situation. The difference is that I have had the benefit of a general theory, one in which all conclusions in all fields are derived from the same set of basic premises. So that when I make the assumption that the laws and principles that I am using are correct -- that's something all of us have to do in order to establish the logical foundations of our results -- I can do the whole thing with one assumption. The astronomers can't do that, because conventional physical theory has no general physical structure. As described by one prominent physicist, Dr. Richard Feynman, in a quotation that I have given many times before, "The laws of physics are a multitude of parts and pieces that

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1. This is a transcript of Mr.Larson's address to the Seventh Annual Convention of the International Society of Unified Science in Philadelphia, on August 13, 1982.

accurate diagnosis of schizophrenia. A person with a split personality would naturally have two different levels of willpower. So that when he was tested with the instrument, there would be a period of time during which one portion of the material would go into solution, while the other portion remained undissolved. Now that was not only a valuable diagnostic tool: it also enabled the investigators to discover some different types of the affliction that were previously unknown to the psychiatrists. For instance, there was horizontal schizophrenia. In that type, one layer of the material dissolved, while another layer remained undissolved. And then there was vertical schizophrenia, in which the same difference was noted between the right and left halves of the container. And then there was mixed schizophrenia, in which the undissolved material was scattered at random throughout the solvent.

Now, Asimov goes on to describe a considerable number of other applications of a similar nature; but these that I have given you are all that we need for present purposes, because what we're interested in is the structure of the story. As Asimov himself explains in his discussion of the story, there is only one assumption contrary to fact introduced into that story. Everything else is strictly according to Hoyle, and the lines of reasoning are sound. So that what we have here is the kind of thing that I have been talking about, a situation in which ninety-nine percent of all what goes into the story is correct, but the whole thing turns out to be nothing but entertaining nonsense, and it culminates in such absurdities as vertical schizophrenia.

I have illustrated that structure of the story in the diagram at the bottom of the page that has been passed out. You will note that the one contrafactual assumption is identified by letters, and then the lines of reasoning lead out to the successive conclusions. The astronomers' structure of the universe is exactly the same kind of a structure, except that they introduce many assumptions contrary to fact, and their universe, the structure of their universe is therefore much more complex. When I talk about structure in that connection, what I am actually talking about, of course, is the framework of the structure. The astronomical universe includes many entities and processes, such as stars, planets, galaxies, and so on, that have to enter into any version of the structure. But those entities and processes are like the side panels and ornamentation on a building. They're just hung on to whatever framework may exist. And it's the framework that determines the character of the structure. It's that framework that I have indicated here.

I have shown the assumptions contrary to fact by letters, just as in the lower diagram, and from them the lines of reasoning, generally sound, lead out to the numbered conclusions, with arrows showing the direction of the reasoning. Where the numbered conclusions refer to entities or processes that are totally non-existent, I've also shown the names. Those numbered conclusions that are not accompanied by names refer to entities or processes that actually do exist, but that differ in some significant way from the description that we get from the astronomers. For example, over on the right of the diagram, conclusion number nine refers to what are known as X-ray stars: they are discrete sources of X-ray emission in the galaxy. Those are actually binary star systems as the astronomers say they are. But one member of each binary system is a quite different object from the one that's portrayed by the astronomers, and the process by which the X-rays are emitted is totally different.

There's one more feature of the diagram as a whole to which I want to call your attention before I start tracing the lines of development. And that is the cumulative effect of more of these assumptions contrary to fact. If you look over on the upper left of the diagram, you will see that the numbered conclusions there are subject to the effects of only one of these contrafactual assumptions, and as a result none of those is listed as totally non-existent. Actually, some of those conclusions are wild enough in themselves, as we'll see when we come to look at them individually, but the real dillies are over on the other side of the diagram, where the effects of three, four or five of these contrafactual assumptions converge.

The first of the assumptions contrary to fact to which I want to call your attention, the one marked A on the diagram, is the assumption that the basic entities of the universe are elementary units of matter. That assumption seemed very reasonable when it was first made. But we now know definitely and positively that it's wrong, because we now know that there are processes whereby matter can be converted to non-matter and vice versa. And obviously, that means that matter cannot be basic. For example, radiation is not a form of matter, and matter is not a form of radiation. But matter can be converted to radiation. Consequently, it necessarily follows that both matter and radiation must be forms of some underlying entity, some common denominator, we may say. That's not a question of opinion or judgment; that's a necessary consequence of the observed facts. The relevance of that point in this present connection is that it sets a limit on the extent to which units of matter can be subdivided into simpler units of matter. For example, if we start with a

rock and examine its structure, we find that it is composed of identifiable material sub-units that we call crystals. If we examine the crystals, we find that they are composed of identifiable material sub-units that we call molecules. But if we continue that process, we eventually come to a material unit that is clearly not elementary, but for which we cannot find any sub-units.

The logical conclusion then is that we have arrived at the point that we know exists, the point where the material unit is not composed of material sub-units, but is composed of the common denominator, whatever that may be. That's the logical conclusion. But the physicists and the astronomers cannot accept that logical conclusion, because they are committed to assumption A which says that the basic units are units of matter. Consequently they have to go out and invent the units that they cannot find. That is the essence, the basis of the quark hypothesis, number one on the diagram. Many prominent scientists have recognized the fallacies in the quark hypothesis. Werner Heisenberg, for instance, was very critical of it. And he also recognized the necessity for a common denominator between matter and non-matter. He suggested that it might be energy; but he admitted that he couldn't see how energy could meet the requirements.

In a universe of motion the common denominator is, of course, motion. But strangely enough, these scientists who have been so able to see the shortcomings of the quark hypothesis have not usually seen that exactly the same considerations apply to the particles that are supposed to be constructed of quarks -- the hypothetical constituents of the atom. No one has been able to find them either. Of course the situation has been confused to some extent in this case by the practice of calling those hypothetical constituents by the names of observed particles. But, as I pointed out in my talk at the conference last year, that practice is totally unscientific.

Identity cannot be established by similarity in names. It has to be established by identity of the descriptions. In scientific terms, two entities are identical in nature if all of their properties coincide. If the bird that we see quacks like a duck and swims like a duck, and so on all the way down the line, then it's a duck. If it crows like a rooster and can't swim, then it's not a duck. It doesn't make any difference how many people insist on calling it a duck, or how nice it would be for somebody's theories if it were a duck -- it still isn't a duck.

The same identical principle applies to these particles. The observed neutron, for instance, is an unstable particle:

it has a life of less than fifteen minutes. And it's gregarious: it has a strong tendency to combine with almost anything that comes along. The hypothetical neutron constitutent of the atom, on the other hand, has to be stable. And it has to maintain its identity even in places where the tendency toward combination is very strong. The pure fact is that they are two totally different particles. Of course, the theorists tell us, the neutron is an accomodating thing, and if we put it in the atom, it will accomodate their theories by becoming stable and by discontinuing this awkward habit of combining with other things. But that's pure nonsense. That's in the same category as saying that if we throw the rooster in the water he will quack and start swimming.

The situation with respect to the other hypothetical particles in the atom is no different. In fact Herbert Dingle tells us that we can't even imagine a particle with all of the properties that are required of the hypothetical electron constituent. But with these imaginary particles (number two on the diagram) the theorists have constructed an imaginary atom (number three).

But even with all of the leeway that they have had for making assumptions as to the properties of these particles of which they wanted to build an atom, they could not construct a plausible theory without making another assumption contrary to fact, the one marked B on the diagram. That is the assumption that the atom does not conform to the normal laws of physics. That's a drastic assumption, and because of that drastic assumption the people who put this structure together in the first place, have had to make the admission that their atom is not a real particle -- that's number four on the diagram. As Heisenberg puts it, "It is in a way only a symbol." Irwin Schroedinger tells us, "If the question is asked, do the electrons actually exist on these orbits within the atom, the answer has to be a decisive no." And Heisenberg specifically cautions us that we must not think that the physicists' atom is a material particle in space and time that exists objectively in the same sense that stones and trees exist. Then what sense does it exist in? Well, he tries to explain that, and he says this: "The atom of modern physics can only be symbolized by a partial differential equation in an abstract multi-dimensional space." Now when we translate that from the professional jargon of the physicist to the vernacular, we find that it says exactly the same thing that I have been saying. The physicits' atom is an imaginary atom constructed of imaginary particles. And in this connection I want to point out that these people that I have been quoting are not scientific heretics like the present speaker. They are eminent members of the group that put this thing together

in the first place. When the present-day physicist wants to apply quantum theory to his problems, it is Schroedinger's wave equation that he tries to solve. Now when he gets into difficulties, it's Heisenberg's principle of uncertainty that he calls on to get him out of those troubles.

In order to go any farther along this line of development that I have started tracing, the astronomers have had to make still another assumption contrary to fact: like the first two, this one was borrowed from the physicists. It's their assumption as to the nature of the process whereby energy is generated in the stars. The physicists' attitude on this subject has never changed. They have contended from the very first that whatever the most energetic process known to them might be, that must be the stellar energy generation process, regardless of how much evidence might exist in any other field of science. The fact that they have had to change their ideas as to the nature of that process twice already, the last time under very embarrassing circumstances, has not changed their attitude in the least. Today there is ample astronomical evidence that their present assumption (assumption C) is wrong, just as there was ample geological evidence in the nineteenth century to show that their then current assumption was wrong. But the physicists are no more willing to listen to the astronomical evidence today than they were willing to listen to the geological evidence during the long and acrimonious dispute with the geologists in the nineteenth century. And since the astronomers are not willing to put up the kind of a fight that the geologists did, they have ignored or rejected the evidence from their own field, and have accomodated their evolutionary theories to the physicists' assumption C. I will have some more to say about the astronomical evidence when we come back to this side of the diagram and start up the line toward conclusion fifteen. But for the moment I want to continue along the original line of development.

The first conclusion that is derived from assumption C is the conclusion that the supply of energy in the stars will eventually be exhausted -- that's conclusion five. The astronomers have then taken that conclusion five and put it together with conclusion three, the conclusion as to the nature of the atomic structure, and they have arrived at the further conclusion that the result will be a collapse of the atom.

I said earlier that the lines of reasoning represented by the lines on the diagram are generally sound; the reason for putting in that qualifying word "generally" is that I have some reservations in some cases, and this line of reasoning leading to conclusion six is one of them. One of the results

of the application of thermal energy to a material aggregate is to introduce additional space between the atoms or between the molecules of the aggregate. And if we eliminate that thermal motion by exhaustion of the fuel supply, it's logical to assume that that additional space will also be eliminated. But the astronomers are going a step farther, and assuming that that exhaustion of the fuel supply also eliminates some further space in the interior of the atom that the thermal motion had nothing to do with in the first place. The justification for that kind of an assumption is very hard to see. Of course, some of the theorists tell us that when the support given by the thermal pressure is eliminated, the aggregate collapses of its own weight. But that is equivalent to assuming that material is heavier when it's cold than it is when it is hot. And there again, that's an assumption that's very difficult to swallow. In the real world the atoms at the bottom of the pile are subject to the weight of all the overlying layers, regardless of whether they are hot or cold.

In one of the books from which I and my contemporaries learned to read, there is a story about a man who is going home with a heavy sack of flour. (In those days, I might say, we bought flour in hundred-pound sacks, not in these little bits of things that they sell in the supermarkets). This man was afraid that the heavy weight would be too much for the horse that he was riding, so in order to relieve the weight on the horse he picked the flour up and held it in his arms on the way home.

Now when we were children we laughed at that story. But now we're presented with exactly the same proposition by the astronomers, in a little different language, and we're expected to keep straight faces. But, after all, I suppose we'll have to remember that what you or I may think about this situation is not relevant in the present connection. What we're trying to do is to examine how the astronomers arrived at these conclusions, and this is their conclusion, number six, and they have concluded, then, that the material of the star collapses into a weird condition that they call "degenerate matter," in which all of the hypothetical space in the hypothetical atom has been eliminated and these hypothetical constituents are in a close-packed condition.

Since this degeneracy starts from a condition in which the material is cold, and therefore solid, it would seem natural to assume that the degenarate matter should be some sort of a super-solid. But no, that's not what they tell us. In some strange way it re-acquires some of the properties of a gas. Particularly, it acquires a substitute for the thermal motion that it can no longer have. So that then instead of cold matter, we have an aggregate of hot degenerate matter --

that's conclusion number seven -- and they have identified that aggregate of hot degenerate matter with the white dwarf star -- conclusion number eight.

I have already mentioned number nine, which is the X-ray star. You will also note that the white dwarf, number eight on the diagram, is connected with item number twenty-three: but that's an incoming line. That refers to the effect of contrafactual assumption D on the white dwarf. Now this assumption D has an effect that is quite different in its nature from the effects of the other contrafactual assumptions that I am discussing. So it will be convenient to defer the effect shown by number twenty-three until we are ready to talk about the situation in the conclusions along the top of the diagram.

So let's move on then to conclusion number ten. The ersatz heat of the white dwarf is supposed to be radiated away in the same way as real heat, although nobody's explained why that should be true. And since that's radiated away, the white dwarf is presumed to gradually cool off, and eventually to become a black dwarf, a cold lifeless object that plays no further part in physical activity. These black dwarfs are purely hypothetical. There is no evidence whatever of the existence of any such thing. And there is no definite evidence that the evolution of the white dwarf is in the black dwarf direction. On the contrary, there is a great deal of evidence showing that some stars, and perhaps all of them, end their lives in gigantic explosions.

The astronomers have had to recognize that evidence, of course, and they've compromised: they've decided that the small stars collapse quietly, and end their lives as black dwarfs, and the big stars explode. And they have identified that explosion with the observed phenomenon known as the supernova. That's number eleven on the diagram. The effect of a gigantic explosion of that kind is to pulverize the material of the star and to eject it out into space in the form of a rapidly expanding cloud of dust and gas. But the astronomers have concluded, and they have some evidence to support that conclusion, that a residue remains at the scene of the explosion. And they have identified that residue as degenerate matter. But they have decided that because of the force of the explosion this matter is more degenerate than the degenerate matter of the white dwarfs. And in some strange way that sounds like magic to me, all of the hypothetical constituents of that degenerate matter are converted to neutrons. So that what we have left is a star composed entirely of neutrons -- a neutron star, number twelve in the diagram.

On the basis of some mathematical conclusions the astronmers have further concluded that there is a limit to the size of a neutron star, and they have decided that when the residue exceeds that size, the contraction under the influence of gravitation goes on until the surface gravity of the aggregate is so strong that no radiation at all can escape. What then exists, they say, is a black hole, conclusion number thirteen. Some theorists are not even willing to stop there. They contend that that contraction under the influence of gravity goes on and on until there's nothing left from the whole star but a single point -- a singularity, in scientific jargon (that's conclusion fourteen).

As you can see from the diagram, all of these bizarre conclusions as to the products of the supernova explosion are subject to the effects of all four of the assumptions contrary to fact that I've already mentioned. And in addition they're subject to one more, which I've identified by the letter E on the diagram. This assumption involves some very basic issues, and I won't be able to explain it in detail in the time that I have this evening, but I can say that in essence what it amounts to is an assumption that the astronomers understand the mechanism of gravitation, which obviously they don't. Again I want to call on Dr. Feynman. He says, "No one has given us the machinery of gravitation; all we have is the mathematical form." Now Dr. Feynman is evidently not familiar with the theory of the universe of motion, because we <u>have</u> given the machinery; but his statement is correct in application to the conventional physics that the astronomers are using.

Now here is a little gem for your collection. "Of all the conceptions of the human mind, perhaps the most fantastic is the black hole. Like the unicorn and the gargoyle, the black hole seems much more at home in science fiction or in ancient myth than in the real universe." If you were not told otherwise, you would probably think that that came from me or from some other hard-boiled skeptic. But no, those are the words of Kip Thorn, one of the most enthusiastic advocates of the black hole hypothesis. Of course, he contends that black holes must exist anyway, no matter how fantastic they are. And after making that statement, he goes on to say this: "The laws of modern physics virtually demand that black holes exist." That's absolutely correct.

The whole point of my presentation then is that all of these absurdities, the black holes and the rest of them, <u>are</u> required by the current laws of physics and the current interpretations of those laws by the astronomers. And that is because those laws and those interpretations have not been purged of the effects of these assumptions contrary to fact

that I have been talking about. The black hole is not science fiction; it's fictional science. The difference is that the science fiction writer knows and admits that he is using assumptions contrary to fact. The practitioner of fictional science either doesn't know or is not willing to admit that he is doing exactly the same thing. The black hole is the astronomical equivalent of vertical schizophrenia.

Moving back now to the other side of the diagram, we note that one of the results of conclusion number five, the conclusion as to the exhaustion of the fuel supply, is that the hot massive stars must be young because they are using their fuel at such a prodigious rate that the exhaustion must come relatively soon, astronomically speaking. This is an inherently improbable conclusion, and a great many astronomers have recognized that. Bart J. Bok, for instance, tells us this: "It is no small matter to accept as proven the conclusion that some of our most conspicuous supergiants, like Rigel, were formed so very recently on the cosmic scale of time measurement." And indeed this <u>is</u> no small matter. What Bok evidently realized is that the product is inconsistent with the process. Natural building processes are slow and gradual. The rapid processes, the catastrophic processes, are destructive. Some new combinations may emerge from those processes, but they're no more than incidental. The general effect of those processes is to tear down, not to build up.

It's generally agreed that the raw material from which the stars are formed must be diffuse matter in the form of dust and gas clouds, and if stars are currently forming, those must be cold clouds. The only known force that is capable of drawing the particles of those clouds together to form stars is gravitation. And because of the immense distances involved the force of gravitation is very weak, and it takes a long long time to operate. The formation of a star is therefore a long, slow process. And the initial product, because it is formed from a cold material, is a cool star, not a hot one. In order to form a hot massive star, another long slow process is required. So that the hot massive star cannot be young, it's an old star. There is plenty of astronomical evidence to support that finding. Most of it comes from observation of the star clusters. Since we find that conclusion fifteen is an erroneous result of an assumption contrary to fact, the same considerations also apply to conclusion number sixteen, and they show that the astronomers have their age sequence upside down. Now they will protest that they have evidence to support that age sequence. But if you examine that evidence, you will find that most of it is evidence only of the existence of a sequence and it has nothing to do with direction. And those items which do refer to

the direction of the sequence contradict the astronomers' conclusions. The most conclusive of that kind of evidence comes from the small clusters that are located in the galaxy, rather than around it. Those clusters, the galactic, or open clusters, can be divided generally into two groups. In one group the constituent stars resemble those of the globular clusters. In the other group they are more like the general run of stars in the galactic arms, such as those in the solar neighborhood. These clusters of both groups are all expanding at measurable rates, and their star density, the number of stars per unit volume, is therefore decreasing. Since there's no reason that we know of why the initial conditions should be any different, it follows that the clusters with the greater average density are the younger, and those with the smaller average density are the older.

Here, then, we have something that is very rare in astronomy -- an opportunity to determine the direction of evolution from direct observation. Now according to studies that have been made, the astronomer Otto Struve tells us, the average density of the group composed of the stars of the globular cluster type is the greater. This is therefore identified as the younger group, which is the opposite of the conclusions reached by the astronomers.

Now this is not the only astronomical evidence that shows that they have their sequence upside down, there are quite a number of other items that I won't be able to discuss tonight because we just simply haven't enough time. But there is one item among them to which I do want to call your attention, because it has a particular significance. This item has to do with the age and origin of the globular clusters. If the stars of those clusters are old, as contended by the astronomers (conlusion number sixteen) then the clusters themselves are presumably old -- that's conclusion seventeen. And the astronomers have therefore decided that they must have been products of the original process of galaxy formation, and are part of the galactic structure -- that's conclusion eighteen. This view encounters some very serious difficulties. One of the most obvious of them is that the clusters do not participate to any significant degree in the galactic rotation, and that is very hard to explain if they are part of the galactic structure. But since conclusion eighteen is a logical result of this line of reasoning, stemming from assumption C, to which the astronomers are committed, they have continued to hold on to this conclusion in spite of all the difficulties, hoping that they will ultimately go away.

But alongside this orthodox evolutionary view of the astronomers, there has in recent years grown up a new concept that contradicts the whole set-up. And since that new con-

cept is accepted quite widely in the astronomical profession, that profession is now in the awkward position where they, or at least a substantial segment of their profession, accept two contradictory explanations for the same thing. This new concept is the concept of galactic cannibalism. Quoting the astronomer Wallace Tucker: "The majority of galactic clusters are dominated by a single massive elliptical galaxy. Apparently these monster galaxies have eaten dozens of their smaller companions." Now obviously, if the giant galaxies can swallow the spirals in their vicinity, the big spirals like ours have the capability of swallowing dwarf galaxies and globular clusters. And in the light of that information, the presence of large numbers of globular clusters surrounding every one of the major galaxies takes on a new significance. In the light of that information it's evident that those globular clusters are not part of the galaxy -- they're external objects that are being drawn in where they can be conveniently swallowed.

Now in that connection it's worth noting that the motions of those clusters that are so difficult to explain on the basis of the astronomers' conclusions, fit in very nicely with the cannibalism hypothesis. Again I want to quote the astronomer Otto Struve. He says they move "much as freely-falling bodies attracted by the galactic center." Of course, on the basis of this new concept, that's just exactly what they are.

Returning now to conclusion fifteen, another one of the consequences of the astronomers' age sequence (conclusions fifteen and sixteen) is that stars must be currently forming in the galaxies, because there are a great many of these hot massive stars in the galaxies, particularly in the galactic arms, and according to the astronomers' viewpoint, those must have been formed fairly recently, and close to their present locations. That confronts the astronomers with a very difficult problem. As I mentioned earlier, the force of gravitation is capable under appropriate circumstances of pulling the particles of the dust and gas clouds together to form stars. The difficulty arises because those appropriate circumstances do not exist in the galaxies.

In order to enable the force of gravitation to do the job unassisted, the dust and gas clouds in the galaxies would either have to be very much larger or very much denser than anything that now exists in the galaxies. So that the astronomers, in order to maintain their theories, have had to try to find some auxiliary process that could work in conjunction with gravitation to produce these results. And they have examined quite a number of processes that they thought might work, but so far they have been unable to produce anything that could stand up to critical scrutiny.

So the result is, as described by an astronomer, Simon Mitten, "The process of star formation is almost a total mystery." When we correct the evolutionary direction, and turn the sequence upside down, the problem disappears; because on that basis there are no stars in the galaxy that are young in absolute terms. It's true that on that basis the stars of the globular clusters, or of the globular cluster type, are younger than the hot massive stars, but that doesn't mean that they are young in absolute terms. It does not preclude their having been formed in some region where the appropriate circumstances for star formation do exist, and having been brought into the galaxy by the capture process.

But since the astronomers accept this conclusion that the stars are currently being formed in the galaxies, they have had to arrive at another conclusion, number twenty, the conclusion that the galaxies are older than the stars that they contain. As it's expressed in one textbook, "According to current conceptions in astrophysics, the galaxies were born first in the universe, and the stars within the galaxies were born afterward. The main reason for believing this to be true is the fact that stars can be seen forming in the galaxies at the present time out of gas and dust." Of course, they can't be seen forming, he merely means that the conditions are such that the theory says that that's where they are forming. Now these ideas as to galaxy formation, conclusion twenty, are very vague. John B. Irwin describes them in this manner. "The Milky Way system, like other galaxies, is thought to have originated from a condensation or collapse of the intergalactic medium. The reason for the collapse is not known, and the details of the process are uncertain." What Irwin is in fact telling us is that astronomers know all about the galactic formation process, except the general nature of the process and the details. L. H. John puts the situation into perspective in this statement: "The encyclopaedias and popular astronomical books are full of plausible tales of condensation from vortices, turbulent gas clouds, and the like, but the sad truth is that we do not know how the galaxies came into being." These are astronomers I am quoting, they are not scientific heretics.

The reason for the difficulty the astronomers are having can be easily understood if it is recognized that their conclusions about the galaxies, number twenty-two on the diagram, are derived not only from this conclusion twenty, which is the result of the line of reasoning that we have been following, but also from a conclusion number twenty-one that directly contradicts conclusion number twenty. This conclusion twenty-one is derived from another assumption contrary to fact. That's the astronomers' assumption that the universe, or at least the present stage of the universe, origi-

nated in a gigantic explosion, the Big Bang as it is called. If they applied the same reasoning that they used in determining their ideas as to the consequences of the supernova explosion, then the explosion that they call the Big Bang would have ejected one part of the material of the universe out into space at high speeds, in the form of an expanding cloud, while another part of the material would have been left at the scene of the explosion in the form of a gigantic black hole. But they are already having serious difficulties in finding some reason why the universe is so isotropic. And if they put a black hole out in the middle somwhere, that would compound the difficulties. So they conveniently ignore what they decided over on the other side of the diagram and on this side of the diagram they decide that the entire contents of the universe, as one textbook puts it, "All of the matter and all the radiation in the universe" is ejected out into space in the form of an expanding cloud.

Now the problem comes then to explain how these particles could have been moving outward at high speeds ever since the Big Bang as required by conclusions twenty-one, and at the same time aggregating into galaxies, as required by conclusion twenty. If you stop to think about that for a little bit you'll understand why the astronomers are having such difficulty, and why their ideas about the formation of galaxies are as vague as these statements have shown them to be.

We've now arrived at the point where we need to take contrafactual assumption D into consideration. As I said earlier, the effects of that conclusion are exerted in a manner that is somewhat different from those of the others. Those other conclusions that I have mentioned tear down the barriers that separate fact from fiction and they permit the astronomers to extend their theories into regions that do not actually exist. The effect of conclusion D, on the other hand, is to set up barriers that prevent them from extending their theories into areas that actually do exist, and they force them to invent various kinds of substitutes.

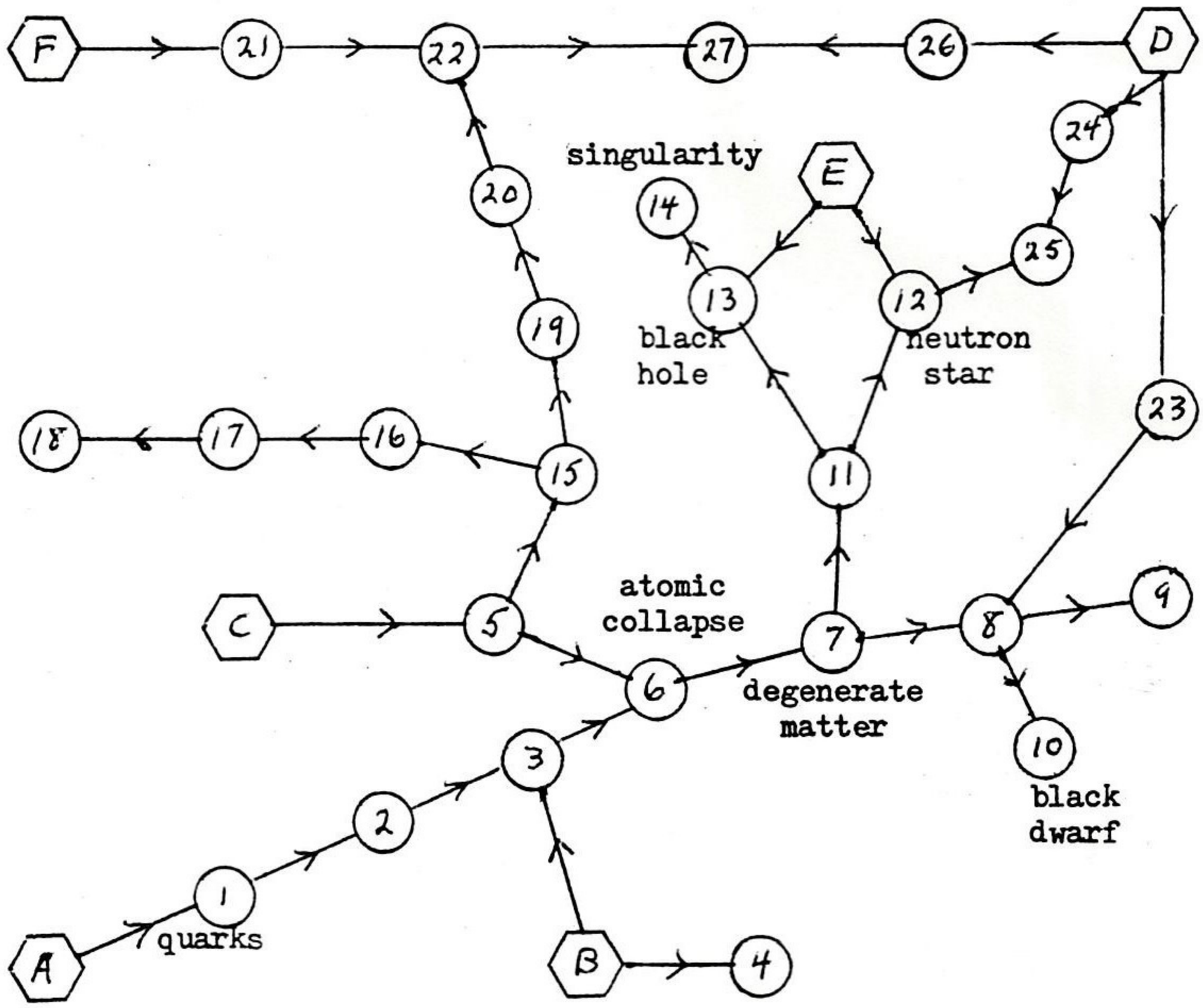
The effects of this conclusion D, which is Eintein's conclusion that the speed of light is an absolute speed limit, are expressed in the form of three prohibitions -- number twenty-three, number twenty-four, and number twenty-six on the diagram. Number twenty-three decrees: "Thou shalt not think of speeds greater than that of light in connection with the high density of the white dwarfs and the products of the supernova explosions." It is this prohibition that forces the astronomers into the strange contortions of thought that result in black holes and singularities.

Number twenty-four similarly dictates, "Thou shalt not think of speeds greater than that of light in connection with the intermittent radiation from the pulsars." The pulsars are number twenty-five on the diagram. And you note that the pulsars get a double dose: they're subject to the prohibitions both twenty-three and twenty-four. The result of this double prohibition can be seen in the present state of knowledge in the field. According to Dr. F. G. Smith, one of the leading investigators in the area, "the manner in which the pulsars are produced is not understood, and little is known about the mechanism of the radiation." That's the result of being prohibited from entering the field of high speeds.

Item twenty-six is another edict, "Thou shalt no think of speeds greater than that of light in connection with the quasars." And since almost all of the observable features of the quasars are a result of speeds greater than that of light, the result is that the astronomers are almost completely baffled by the quasars. There is no better fundamental understanding of the quasars now than there was when they were first discovered, twenty years ago. There has been a great deal of empirical information gathered, but there is no understanding of that information. The general tendency in astronomical circles is to blame the physicists. As expressed by one prominent astronomer, Garry Vershuur, "the existence of quasars strongly suggests that we are dealing with phenomena which present-day physics is at a loss to explain." Now that's true. But the astronomers can't evade all responsibility. They did not have to accept all of these contrafactual assumptions that the physicists have made.

When the first pulsar was discovered, the regularity of the pulses suggested that they might be artificially created, and for a time it was fashionable to refer to them as messages from little green men. When more pulsars were found, it was realized that the pulsars must be natural objects, and the little green men were dropped. That may have been a mistake. This universe that the astronomers have worked so hard to construct is not of much use to us except for entertainment, because we are so consituted that we cannot deal physically with things that are not physical. We have to have things which, as Heisenberg says, exist in the same sense that trees and stones exist. But this universe that they have built would be a very appropriate home for the little green men, perhaps even degenerate little green men.

THE MYTHICAL UNIVERSE OF MODERN ASTRONOMY



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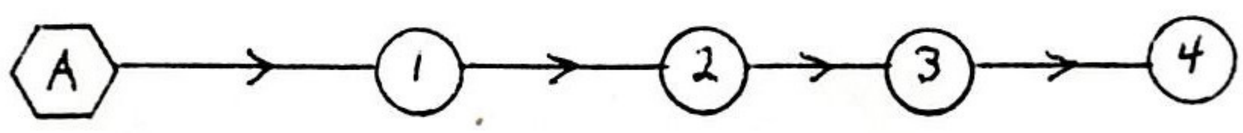

Contrafactual assumption

Lines of reasoning and successive conclusions

ANOTHER LOOK AT THE PULSAR PHENOMENON

by K.V.K. Nehru

Astronomers have recognized in the pulsars, the extremely compact pulsating stellar objects, opportunities to test the correctness of the predictions of different theories of gravitation. In fact, the substantial amount of accurate observations accrued on the binary pulsar PSR 1913+16 by J.H. Taylor et al.[1],[2] brings this goal nearer to achievement. It is, therefore, possible to test the Reciprocal System on the basis of the information now available on PSR 1913+16 and other pulsars.

According to the Reciprocal System, a pulsar is the ultra-high-speed product of a Type II supernova explosion -- the result of reaching the upper rotational limit of matter. In Quasars and Pulsars[3] Larson gives a brief account of the origin and characteristics of pulsars. Arnold Studtman[4] in his doctoral dissertation Towards a Unified Cosmological Physics gives a critique of Larson's theory of pulsars. A study of these raises some issues that need clarification.

1.0. Firstly: we recall that quasars, too, like the pulsars, are the result of gigantic Type II explosions which impart sufficient speed to carry them past the neutral point and into the region of motion in three-dimensional time. The overcoming of the gravitation that gives rise to the pulsation phenomenon is present in the quasar situation as well. As such, the reason why the pulse phenomenon is not apparent in the case of quasars must be explained.

2.0 If Larson's account of the pulse mechanism is correct, it can be seen that the duration of each pulse cannot be more than a few natural units of time (n.u.t.), at the most, beyond the point where gravitation has decreased to half of unit value. But such a conclusion is not consistent with the observed fact, since the pulse widths range from about 5 to 30 milliseconds. For instance, at the point where gravitation is down to 0.500, half of the radiation from the ultra high speed explosion product is observable in space and the other half is unobservable. We thus receive radiation for 0.152×10^{-15} seconds, after which there is a quiet interval of 0.152×10^{-15} seconds, then another flash of radiation, and so on.[5] Here it is important to note that the fraction to which the unit gravitational speed is reduced gives the ratio of the pulse duration to the pulse period. Thus, in the above example, when gravitation has come down to 0.5, we find that there is radiation for a duration of one n.u.t. succeeded by a quiet interval of one

n.u.t. Thus the period is two n.u.t., and the ratio of pulse duration to pulse period is 1 n.u.t./2 n.u.t. = 0.5.

Now suppose that gravitation has come down to 0.4. In this case, as far as the radiation is concerned, the proportion of the spatially active time units to the spatially inactive time units is 0.4 to 0.6. Since there are no fractional units, we find that there will be a radiation pulse for a duration of 2 n.u.t., followed by a quiet interval of 3 n.u.t., yielding a pulse period of 5 n.u.t. -- the smallest whole number of n.u.t. possible. However, the ratio 2/3 of the spatially active to the spatially inactive units is not the only one which is equal to the ratio 0.4/0.6. The ratios 4/6, 6/9, 8/12, etc. are all mathematically equal to it. But the 2/3 ratio is the most probable one since it involves the least number of consecutive units of any one kind, spatially active or spatially inactive, in continuous succession. Thus, as the gravitation goes on attenuating, the pulse period increases, but the pulse duration does not grow, being constrained by the discrete unit postulate and the probability principles. By the time the pulse period has grown to an observationally detectable size, the pulse duration remains in the range of one n.u.t. to a few femtoseconds. But this conclusion is at variance with the actual observed pulse widths. Neither Larson nor Studtmann points out this discrepancy.

2.1. One way to get over this problem seems to be by realizing that the magnetic explosion which drives the stellar matter to the superluminal speeds does not impart those speeds to all parts of the affected material at the same instant of time. Presumably the inception of the explosion takes place at the center of the star and spreads to the outer layers at the speed of light. Consequently, different portions of the star enter the region of motion in three-dimensional time at different instants. This engenders a phase difference among the radiation pulses given out by these various portions, while their respective pulse periods will be the same, since the period is determined by the degree of attenuation of the gravitation and not by the epoch of their reaching the gravitational limit. Thus the observed pulse can be seen to be the result of juxtaposing individual subpulses (from the different portions), each of duration not more than a few femtoseconds.

A total pulse width of 10 milliseconds, say, implies that the portion of the original stellar material that became the pulsar is of radius

$$(10 \times 10^{-3} \text{ sec}) \times (2.99793 \times 10^{5} \text{ km/sec}),$$

equal to 0.0043 solar radii; the outlying material being dispersed into space to form the SNR (supernova remnant). This does not mean that only material within a radius of 3000 km underwent the catastrophic explosion. The explosion might continue to larger radii, but the speed imparted to it becomes less than is necessary to transport the matter to the region of three-dimensional time. Thus, knowledge of the pulse width will enable one to estimate the fraction of the original star's mass that went into the pulsar.

3.0. The next difficulty with Larson's account of the pulse mechanism concerns the occurrence of two separate peaks in the pulses of many pulsars (like CP 0834, CP 1133, NP 0532, PSR 1913+16, etc.) No explanation has been offered for this from the framework of the Reciprocal System. In the conventional lighthouse model, the double peak is explained by suggesting that the pulsar beam is a hollow cone and the peaks could be the two sides of the cone sweeping past our earth. Though this suggestion is perfectly legitimate, the process whereby such a hollow cone beam of polarized radiation can be generated in the pulsar is far from being understood.

3.1. Two ways of accounting for this pulse structure seem possible in the context of the Reciprocal System. Larson points out that the distribution of emitted radiation takes place two-dimensionally ". . . when (it) originates in the region of ultra high speeds, where physical action takes place only in two scalar space-time dimensions, and not in 3-dimensional space or time."[6] Furthermore, this is also the reason for the radiation to be polarized, as it is constrained to the two dimensions. It is not clear why Larson, while asserting both the two-dimensional distribution of radiation and its polarization in the case of the quasars, highlights only the polarization aspect with nothing more than a passing reference to the planar emission in the case of the pulsars.

The double peak can easily be explained if the pulse production is regarded as being due to the 2-dimensional distribution of the pulsar radiation coupled with the fact of the rapid spinning of the pulsar. Two peaks are the result if the angle between the spin axis and our line of sight is greater than the angle of tilt of the radiation plane relative to the spin axis.

3.2. The second alternative is the explanation offered in item 2.1. above. As the total pulse is seen to be made up of an ensemble of phase-shifted micropulses originating from different zones that are transported to the realm of

motion in 3-dimensional time at different moments, the general shape of the pulse gives an idea of how the explosion progressed.

Obviously the first material to reach superluminal speeds is that nearer the center of the star where the explosion begins. In the normal course, the explosion spreads radially outward in an expanding spherical shell. Therefore, as the explosion progresses, the quantity of the material involved in the explosion increases nearly as the square of the radius, in the initial stages, with the consequent rise in the magnitude of the explosion. This manifests itself as the corresponing increase in the amplitude (luminosity) of the successive subpulses, starting from zero. However, as the explosion front progresses to larger radii it encounters material at lower and lower densities -- the decrease in the density eventually more than offsetting the increase in the spherical area. This results in a fall in the intensity of the explosion and shows up as a decrease in the amplitude of the successive subpulses.

However, if the size of the exploding star is very large, the above phenomenon is modified. The densities in such a star in the regions beyond the initial parts of the explosion are greater compared to a star of smaller size. Under these conditions, the advancing compression wave due to the explosion in the inner regions is usually sufficient to raise the material density at a larger radius and to step up the strength of the explosion again, resulting in the second peak. It may also be noted that in such a case the height of the second peak has normally to be less than that of the first. In the case of a smaller star the second peak does not occur for the reason that the pressure wave simply ejects the low density matter in the outer layers outward, forming the remnants.

The Type II supernova, which is the origin of the pulsar, is the result of reaching an age limit. This also means that the general size of the star is comparatively large (due to accretion) and hence the double peak in the pulse need not be a rare feature. As already remarked, the shape of the pulse is the signature of the explosion. With a knowledge of the density profiles in stars and the kinetics of the explosion it is not difficult to calculate the critical size of the star necessary to produce two peaks in the pulse. Since, as already noted, the pulse duration gives an idea of the radius of the parent star involved in the explosion, it is possible to estimate the mass of the pulsar, its radius, period of rotation, density, luminosity, and average temperature.

4.0.1. The next difficulty is concerning the calculations of the lifetimes. In Quasars and Pulsars Larson explains that the pulsar is continuous until the inner gravitational limit is reached in the explosion dimension. Beyond this distance there is a pulsation with an increasing period. There is also another distance, the outer gravitational limit, beyond which there is no gravitational effect at all and hence the pulsar is not visible as it "leaves the material sector" of the universe. In the Structure of the Physical Universe Larson evaluates these two gravitational limits for a star of one solar mass as being 2.26 and 13350 light years respectively. Consequently, he points out that the life of a one-solar-mass pulsar is limited to about 13,000 years.

Further, as the continued attenuation of the gravitation -- which is responsible for the gradual increase of the pulse period -- is related to the inverse square of the distance traveled (in time) Larson arrives at the following relation between the period P and the age A:

$$P = KA^2$$

where K is a constant. Since both the age and the period of the Crab Nebula pulsar, NP 0532, are known, he calculates the value of the effective inner gravitational limit in the case as being 6×10^{-5} light years.[7]

The inner and outer gravitational limits of a star of m solar masses are respectively given by

$$d_o = 2.26 \sqrt{m} \text{ and } d_1 = 13350 \sqrt{m} \text{ light years.}$$

Therefore, their ratio:

$$d_1/d_o = 13350/2.26 = 5907.1$$

is seen to be independent of the mass. Thus the outer gravitational limit in the above case of NP 0532 works out to be

$$d_1 = 5907.1 \times (6 \times 10^{-5}) = 0.354 \text{ light years.}$$

This means that its life is limited to 0.354 years, of 130 days! Thus there is an unresolved incompatibility between the requirement of a small inner gravitational limit as little as 6×10^{-5} light years (to account for the pulsar's present period) and the requirement of an outer gravitational limit as being nearly 13350 light years (to account for the lifetime).

4.0.2. Studtmann[8] estimates the masses of several pulsars on the basis of a relation involving the maximum possible age of a pulsar. For example, the maximum pulse period, for the Vela pulsar, PSR 0833, is computed to be 5.2345 seconds. Then on the basis of $P = KA^2$ relation, the A<max> of PSR 0833 is calculated to be

$$1503 \times (5.2345/0.0892)^{\frac{1}{2}} = 11514 \text{ years}$$

where 0.0892 seconds is its present (1969 value) pulse period at the age of 1503 years. Comaring this maximum age with that of a one solar mass pulsar, namely 13350 years, he calculates the mass of PSR 0833 as $(11514/13350)^2 = 0.74$ solar masses.

However, there is an inconsistency in the calculations. This stems from the fact that the present age of the Vela pulsar, 1503 years, used in the above computation is, in the first instance, arrived at in an earlier calculation[9] on the basis that its mass is one solar mass. To be precise, the fact that the value of the constant K in $P = KA^2$ is dependent on the mass of the pulsar seems to have been overlooked. The period P_o of the pulsar at an age A_o, when it just arrived at the inner gravitational limit d_o, is one n.u.t. Since $d_o = A_o$ (when the former is expressed in light years and the latter in years)[10] we have

$$A_o = 2.26 \sqrt{m}$$

(see item No. 4.0.1. above). Thus

$$K = P_o / A_o^2 = 1.52 \times 10^{-16} / 2.26^2 m$$

Moreover, it will be seen that if $P = KA^2$ is to be true, the maximum possible period, whatever might be the pulsar's mass, turns out to be

$$P<max> = (13350/2.26)^2 \times 1.52 \times 10^{-16}$$

$$= 5.31 \times 10^{-9} \text{ seconds!}$$

Once again the inference seems to be that the inner gravitational limit of 2.26 light years is too large.

4.0.3 The next difficulty of the same category is concerning the time derivative of the period, P. Studtmann[11] describes how Larson, from the three relations, $P = KA^2$, A is inversely proportional to P<effective>, and $P<effective>^3 = P<measured>$, concludes that P<measured> is inversely proportional to P raised to the power of 1.5. But since age A is time, from $P = KA^2$ we have $P = 2KA$. How A is taken to be inversely proportional to P is not clear.

5.0.1. The next category of difficulty is about the pulsar gravitation. Do pulsars exhibit additional redshift like the quasars, which according to the theory arises out of the motion in time?

5.0.2. Because of the ultra high range of speeds imparted to the pulsar material, the material is expanding in time and the gravitation that seems to be acting is gravitation in time. If pulsar gravitation is in time, it is not clear how a pulsar can ever form a binary system (like PSR 1913 + 16, for example).

5.0.3. Further, it must be recalled that gravitation is an inward scalar motion inherent in the very scalar motion forming the material atoms. So long as the material type of atomic rotation is extant, it is not clear how the concomitant gravitation can be anything other than spatial. In the case when the gravitation in space is completely offset by the speed imparted by the explosion, it must be recognized that the explosion speed can only counteract the translational aspect of the gravitation, and cannot nullify the positive scalar rotation much less convert it to the negative rotation of the cosmic atoms which is the source of the gravitation in time. Consequently, even though the two extra units of speed transport the material into the cosmic sector where the gravitation in time is operative, the atoms with the material type rotation cannot form aggregates in 3-dimensional time -- they move outward in time as well as space.

6.0. Explaining the pulsing at X-ray frequencies occurring in the case of some pulsars, Larson says ". . . accreted low-speed matter will interact with the adjacent portions of the pulsar, and will reduce the speed of some of its constituent particles below the unit level, causing the emission of x-rays . . . Inasmuch as all of the three types of radiation, radio, X-ray, and optical, originate in the rapidly moving pulsar, the pulsation rates will be the same for all."[12]

But the retarding of the superluminary matter to the region below unit level (thereby causing X-ray emission) will also eliminate the cause for the pulsing phenomenon, since in that speed range radiation is emitted continuously, that is, in every unit of clock time.

6.1 It is suggested that, on the other hand, the x-ray emission could be the result if some portions of the pulsar material are accelerated from the 2-x speed range to the 3-x range, since this speed range brings the motion back into space again (in the second scalar dimension).

7.0. Larson states: "At this . . . 0.500 distance, half of the radiation from the ultra high speed explosion product is observable in space and the other half is unobservable."[5] This description, I think, can be misunderstood by imagining that though the other half of the radiation is unobservable in space, it nevertheless exists. But this is impossible because the photons of radiation, having no independent motion, progress scalarly outward at unit speed and are observable either from the naterial sector or from the cosmic sector. "The other half" which Larson refers to as being "unobservable" must be radiation which was never emitted. The term "radiation observable in space" could be misleading too.

In his Structure of the Physical Universe, Larson very clearly explains the mechanism of the emission of radiation, making use of the Principle of Inversion. "From this principle we find that the thermal motion of the atoms of matter is in equilibrium with a similar vibratory motion of the space units in which they are located. . . . and as space-time progresses it carries this vibrational motion of the space units along as radiation."[13] The atoms enter new space units as they are moving inward in space (while space-time is progressing outward), and these new units also acquire the vibration and become photons.

So long as the material atoms are continuously moving from one space location to another (in the inward direction) by virtue of their gravitational motion, each successive space unit traversed turns into a photon, and the radiation is continuous. If the radiation is to be intermittent -- as in the case of the pulsars -- this can happen only if the motion of the atom is intermittent. For instance, in the example cited by Larson, where the gravitation is down to 0.500, the atoms move inward to the adjoining space unit in one unit of time and in the next unit of time their movement is coincident with the background space-time progression. From the foregoing it can be seen that if L_o is the luminosity calculated from the Stefan-Boltzmann Law, the actual luminosity L is proportional to L_o/P where P is the pulse period, because the energy leaves the atoms only intermittently. If this argument is legitimate it must lead to the correct theoretical identification of the relationship between the radio luminosity and the period.

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PROGRESS ON THE THEORETICAL CALCULATION OF COHESIVE ENERGY OF THE ELEMENTS

by Ronald W. Satz

A previous paper of mine[1] presented a semi-theoretical equation for cohesive energy of a pure solid at zero temperature and zero external pressure. Since then I have been able to work out a more theoretical expression, which is as follows:

$$U = [(P_o * V_o^2/V] - E_o \qquad <1>$$

where:

U = cohesive energy of pure solid at zero temperature
V_o = volume at zero temperature and zero external pressure
V = volume at zero temperature and any external pressure
P_o = internal pressure
E_o = zero-point energy

With eq. <1> we can easily calculate the bulk modulus, which is defined as

$$B = V * (d^2U/dV^2) \qquad <2>$$

(dropping the sign, since U is also treated as positive).

Here,

$$dU/DV = - [P_o * (V_o^2]/V^2$$

$$d^2U/dV^2 = (2 * P_o * V_o^2/V^3$$

Thus

$$B = V * [(2 * P_o * V_o^2/V^3] = (2 * P_O * V_o^2/V^2 \qquad <3>$$

At zero external pressure and temperature, $V = V_o$, and so

$$B_o = 2 * P_o \qquad <4>$$

This equation was previously derived by Larson from the postulates of the Reciprocal System.

Now if in eq. <1>, $V = V_o$, then

$$U_o = P_o * V_o - E_o \qquad <5>$$

The term E_O is easily calculable from the zero-point temperature, T_O , and is found to be negligible (except possible for the noble elements). The term V_O is also easily calculable; it is

$$V_o = G * N * s_o^3 \qquad <6>$$

where

G = geometric factor of crystal
N = Avogadro's number
s_o = nearest neighbor distance.

However, the term P_o, in application to cohesive energy, has turned out to be different than previously thought. The original equation was

$$P_o = (K * a * z * y)/s_o^3 \quad <7>$$

where

k = numerical constant
a, z, y = compressibility factors of material

The factor **y** (the number of effective rotational units in the third dimension) has been found in the present application to be equal to 1 in all cases, not merely in most cases. Since the value of **a** (the number of effective magnetic displacement units) is always 4 (except for the noble elements) this leaves **z** as the only adjustable term. Here, **z** is the number of effective electric displacement units, ranging from 1 to 8. The value of **z** in the present application has been found in nearly all cases to be either the value of **z** used in the compressibility relations or the value of **z** used in the thermal relations or some intermediate value. Let **z'** denote this modified **z** value; then the reduced equation for cohesive energy is

$$U_o = 100.56 * G * Z' \text{ (KJ/mole)} \quad <8>$$

Table II of the previous paper is reproduced here with the revisions in the calculations. The last two columns are the experimental values from Kittel[2] and Zhdanov.[3] Note that the two experimental values for each element sometimes differ by more than 20 percent.

The equation given in the previous paper for the cohesive energy of the noble elements, $U_o = \frac{1}{2} P_o V_o$, produced the correct values, but as matters now stand it is theoretically unacceptable since the thermal ½ factor is already taken into account in P_o. Since **z'** is determined by electric displacement and since the noble elements have zero electric displacement, an equation different from equation <8> will have to be worked out for these elements. Possibly equation <5> can be used with $E = \frac{1}{2} P_o V_o$.

TABLE II of previous paper -- revised

Zth	Zcomp	elem.	G	a	Z'	U= 25.146aZ	Kittel Uexp	Zhdanov Uexp
2,1	1	Li	0.770	4	2	154.86	158	163
2,1	4	Be	0.752	4	4	302.48	320	314
4	6	C	1.554	4	5	781.35	711	
1	1	Na	0.770	4	1	77.43	107	108
1	4	Mg	0.708	4	2	142.39	145	152
2,1	5	Al	0.707	4	4	284.38	327	230
6	4	Si	1.543	4	3	465.49	446	
1	1	K	0.770	4	1	77.43	090.1	083
3	3	Ca	0.707	4	3	213.29	178	200
8	8	Ti	0.731	4	6	441.06	468	419
8,6	8	V	0.770	4	6	464.59	512	356
8	8	Cr	0.770	4	5	387.16	395	368
8.5	8	Mn	1.087	4	3	327.93	282	310
8.6	8	Fe	0.770	4	6	464.59	413	393
8,6	8	Co	0.696	4	6	419.94	424	356
8,6	8	Ni	0.707	4	6	426.58	428	356
6	6	Cu	0.707	4	5	355.48	336	340
3	4	Zn	0.809	4	2	162.71	130	115
8	4	Ge	1.541	4	3	464.89	372	356
	1	Rb	0.770	4	1	77.43	082.2	079
	3	Sr	0.707	4	3	213.79	166	197
4	6	Zr	0.731	4	8	588.07	603	460
	8	Nb	0.770	4	8	619.45	730	
8	8	Mo	0.770	4	8	619.45	658	670
8,6	8	Ru	0.730	4	8	587.27	650	508
8,6	8	Rh	0.707	4	7	497.67	554	481
4	8	Pd	0.707	4	6	426.58	376	460
3	8	Ag	0.707	4	4	284.38	284	285
2	4	Cd	0.816	4	2	164.11	112	112
6	4	In	0.762	4	3	229.88	243	218
2,1	4	Sn	1.543	4	2	310.33	303	327
3	4	Sb	1.227	4	2	246.77	265	167
1	1	Cs	0.770	4	1	77.43	077.6	079
1	2	Ba	0.770	4	2	154.86	183	205
2	4	La	0.721	4	6	435.02	431	377
	4	Ce	0.707	4	6	426.58	417	
1	4	Pr	0.722	4	5	363.02	357	
1	4	Nd	0.698	4	5	350.95	328	
1	4	Sm	0.716	4	3	216.00	206	
2	4	Gd	0.722	4	6	435.63	400	
2	4	Dy	0.732	4	4	294.44	294	
1	4	Ho	0.732	4	4	294.44	302	
1	4	Er	0.736	4	4	296.05	317	
1	4	Tm	0.679	4	4	273.12	233	
1	2	Yb	0.707	4	2	142.19	154	

Zth	Zcomp	elem.	G	a	Z'	U= 25.146aZ	Kittel Uexp	Zhdanov Uexp
	4	Lu	0.732	4	6	441.66	428	
3	8	Ta	0.770	4	8	619.45	782	
6	8	W	0.770	4	8	619.45	859	879
6,5	8	Ir	0.707	4	8	568.77	670	502
3	8	Pt	0.707	4	8	568.77	564	
1	8	Au	0.707	4	4	284.38	284	
1	4	Tl	0.690	4	3	208.16	182	
1	4	Pb	0.707	4	4	284.38	265	
2	3	Bi	1.224	4	2	246.17	210	
	8	Th	0.707	4	8	568.77	598	
	8	U	0.998	4	6	602.15	536	

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